Add-on Pricing, Consumer Myopia and Regulatory Intervention

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Abstract

This paper analyzes regulatory intervention when firms exploit consumers who are myopic in their decision making. As shown by Gabaix and Laibson (2006), a potential equilibrium price strategy of firms involves excessively high-priced add-ons and shrouding of add-on prices, which leads to a social welfare loss and consumer protection problems. Our model introduces a *price discrimination* equilibrium, and a regulator who educates myopic consumers about the relevance of add-on prices before firms decide on their pricing strategy. Such efforts to correct individuals' factual mistakes are largely uncontroversial in politics and the academic literature. In contrast to this view, we show that regulatory intervention via educating consumers can decrease social welfare and weaken consumer protection. This is the case if education efforts are insufficient to change a price equilibrium with high-priced add-ons or with price discrimination.

Keywords: bounded rationality, information suppression, regulation, social welfare, consumer protection

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1 Introduction

When consumers are boundedly rational and myopic in their decision making, firms will try to exploit it. Well-known examples are that consumers book a hotel room without considering the costs of the minibar, buy a computer without considering the costs for upgrades, or open a bank account without considering fees for additional banking services. As shown by Gabaix and Laibson (2006), the equilibrium pricing strategy of firms then may be to compete purely on the price of a base good (e.g., a hotel room, computer without upgrades, or bank account) and to suppress information about add-ons (e.g., the minibar, computer upgrades, or banking fees). The firm picks a price for the base good below marginal costs, and a price for the add-on above marginal costs. Consequences for consumers are twofold: First, sophisticated consumers substitute away from add-ons, which creates a social welfare loss if substitution is costly. Second, myopic consumers who buy the high-priced add-on subsidize sophisticated consumers, which raises consumer protection concerns. The question arises if and how the regulator should intervene to maximize social welfare and consumer protection.

In many situations, vigorous competition is the single best instrument for efficient market outcomes and for protecting consumer interests, and regulation is not needed (Armstrong, 2008). Regulation and consumer protection policies may even have possibly undesirable effects if it leads to a weakening of competitive pressures (e.g., Armstrong, Vickers, and Zhou, 2009). In some specific situations, however, regulatory intervention can help markets function better. For example, there can be a role for regulation to create transparency (Spiegler, 2006b,a). If regulatory intervention benefits vulnerable consumers without harming more sophisticated consumers, it is relatively uncontroversial. If interventionist consumer policies benefit one group of consumers at the expense of another, it is not so clear if regulatory intervention is warrented (Armstrong, 2008).

This paper analyzes regulatory intervention when firms exploit consumers who are myopic in their decision making. Our analysis has two important features: First, a regulator is introduced who may educate a fraction of myopic consumers about add-on prices before firms decide on their pricing strategy.[1] Regulatory intervention could be through general public information or requiring "warning labels" placed on marketing materials. The rationale for such an intervention is that *shrouding* information about add-ons only prevails for a sufficiently high portion of uninformed myopic consumers, and that *unshrouding*, which is socially desirable, prevails other-

[1]Gabaix and Laibson (2006, 530-31) discuss verbally alternative remedies that the regulator can consider, but do not go into detail or derive formal results.

wise. Such efforts to correct individuals' factual mistakes are largely uncontroversial in politics and the academic literature (see, e.g., Jolls and Sunstein 2006).[2] Second, firms own a technology that allows them to price discriminate between myopic and sophisticated consumers (more or less successfully). This may lead to new price equilibria, and mitigate the social welfare problem even without regulatory intervention. However, it may also have adverse effects, and it will not solve potential consumer protection concerns. Effects of regulatory intervention therefore also depend on the potential of firms to price discriminate.

Generally, price discrimination exists when the difference in prices among consumers is not proportional to the difference in marginal costs. We consider price discrimination that is based on observed consumer heterogeneity, called *third-degree* or *direct* price discrimination.[3] The firm offers add-on products at different prices to consumers who the firm considers to be myopic or sophisticated. To our knowledge, this is the first model that considers price discrimination of add-ons, i.e. the offering of a base good and differently priced add-ons.[4]

To illustrate consider the following example. Suppose a bank offers a cash account (the base good) and one or two investment funds (the add-ons). The first fund is a high-priced managed investment fund and the second fund is a low-priced exchange traded fund (ETF). Suppose that both funds tracks the same index, and that both funds can be considered as perfect substitutes. The pricing strategy of the bank then involves two decisions. First, whether its range of products consists of the managed investment fund, the ETF, or both funds. Second, whether to compete purely on the price of the base good (cash account), or to also advertise the add-ons. If the bank owns the technology to price differentiate between myopic and sophisticated investors, the bank can shroud information about add-ons towards myopic consumers and offer them managed investment funds once they open a cash account. Furthermore, the bank can unshroud information about ETFs towards sophisticated consumers.[5]

[2] What is not so clear is if educating consumers is a cost-efficient strategy, and if its efficient in changing the behavior of myopic consumers. These mitigating effects are not considered in this paper. We focus on the effects of increasing the fraction of informed consumers that are uncontroversial in the literature.

[3] For a literature review, see Armstrong (2006), Esteves (2009), Fudenberg and Villas-Boas (2006), or Stole (2007).

[4] Note that some related papers about add-on pricing use the term price discrimination with a different meaning than our paper. For example, Ellison (2005) considers firms that offer a base good to *cheapskates*, and a base good plus a high-priced add-on to consumers with higher valuations for quality. He does not consider firms that offer a base good plus a low-priced or a high-priced add-on.

[5] ETFs are traded on the German stock exchange since 2000. However, until recently most banks in Germany offered only managed funds and no ETFs. This seems to change. Deutsche Bank, for example, offers ETFs under the name *db x-trackers* since 2007. The German savings banks offer ETFs under the name DEKA since 2008. An exception is, e.g., Citibank Deutschland (now part of Credit Mutuel Group) who does not offer own ETFs. Until 2008 Citibank Deutschland even did not allow customers to buy ETFs from external providers into their securities account, officially

Our main results are as follows. First, if regulatory intervention changes a *high-priced add-on* equilibrium or a *price discrimination* equilibrium of firms, social welfare increases. Second, if regulatory intervention does not change a *high-priced add-on* equilibrium or a *price discrimination* equilibrium, social welfare decreases. Finally, if a *low-priced add-on* equilibrium exists without intervention, intervention is obviously irrelevant because there is no social welfare loss in the first place. Effects depend on the fraction of myopic consumers, the efficiency of educating myopic consumers, the effort costs of substituting away from add-ons, the upper level for the add-on price, and the efficiency of price discrimination. In summary, the regulator needs to carefully analyze the situation before intervening via educating myopic consumers and may find no intervention at all or other regulatory strategies more beneficial.

The paper proceeds as follows. Section 2 contains details of the model (2.1), the price equilibria when the regulator decides not to educate myopic consumers (2.2), and the price equilibria when the regulator decides to educate myopic consumers (2.3). Section 3 discusses implications for social welfare and consumer protection. Finally, Section 4 contains concluding remarks.

2 The Model

The following pricing game is closely related to the model of Gabaix and Laibson (2006). The innovation of our model is twofold. First, the model allows firms to choose price discrimination besides uniform pricing. Second, a regulator may intervene and educate myopic consumers about the relevance of add-on prices.

2.1 Details of the model

Firms produce base goods and add-ons. Add-ons are always avoidable for informed consumers, in contrast to unavoidable *surcharges*. For simplicity, marginal costs for the base good and for add-ons are zero. The mass of consumers is normalized to 1.

Consumer types. Two types of consumers are considered: myopic consumers, a fraction α of all consumers with $\alpha \in (0, 1]$, and sophisticated consumers, a fraction $1 - \alpha$, of all consumers. Myopic consumers per se only take the price for the base good into consideration when deciding where to purchase a good. Sophisticated

because of "technical difficulties".

consumers always take both the price for the base good and the price for the add-on into consideration when deciding where to purchase a good.

Advertising: shrouding and unshrouding. *Shrouding* means that the firm suppresses information about the price of the add-on. *Unshrouding* means that the firm provides information about the price of the add-on. By providing this price, the firm at the same time educates a fraction λ of myopic consumers about the relevance of the add-on price. A fraction λ of myopic consumers, called *informed myopic*, becomes informed. Unshrouding is free.

Regulatory intervention. The regulator can educate myopic consumers about the relevance of add-on prices. This increases the fraction of informed consumers before firms decide on a pricing strategy. Regulatory intervention through education implies that a fraction λ of myopic consumers, called *educated myopic*, becomes informed myopic. It is assumed that education by the regulator and *unshrouding* by firms are substitutes. There is no complementary effect if the regulator educates and firms *unshroud*, such that the fraction of *educated/informed myopic* is at most $\lambda\alpha$. The intuition for this assumption is that a fraction of $(1-\lambda)\alpha$ of the population is just not receptive for any kind of information, or not capable to use any but the most simple decision rationale. Educating consumers if free.

Pricing. The firm chooses a price for the base good, p, and a price for the add-on, $\hat{p}$. In case of price discrimination, the prices of the low-priced add-on and the high-priced add-on are denoted as $\hat{p}_L$ and $\hat{p}_H$. The prices for the add-ons have an upper bound, $\bar{p}$. No consumer will buy an add-on above this price. All prices refer to firm i, and, for simplicity, the subscript i is omitted. For simplicity and without loss of generality, we set $\bar{p} \in (0, 1]$[6].

Demand function. The demand function of firm i is modeled as the probability density function that a consumer purchases at firm i, $D(x_i) \in [0, 1]$, where x_i represents the *anticipated net surplus* from purchasing a product at firm i less the *anticipated net surplus* from purchasing a product at the best alternative firm. The demand function $D(x_i)$ is strictly increasing and reflects the degree of competition in the industry that is given by $\mu = \frac{D(0)}{D'(0)}$. Perfect competition corresponds to $\mu = 0$.[7] The arguments of the decision rationale x_i depend on the consumer type

[6]This makes Corollary 3 simpler, otherwise it does not matter.

[7]The demand function $D(x_i)$ is derived from a decision utility of a consumer a that is given by $U_{ai} = v_i - q_i + \varepsilon_{ai}$, where v_i represents the quality of a product at firm i, q_i represents the price

that is either an *informed consumer* (sophisticated or educated/informed myopic) or an *uninformed consumer.*

- For uninformed consumers, x_i is given by $\bar{x}_i = -p+p^*$, where p represents the price for the base good at firm i, and p^* represents the price for the base good at the best alternative firm. Uninformed consumers ignore prices of add-ons when they make their buying decision.
- For informed consumers, x_i is given by $\hat{x}_i = -p - \min\{E\hat{p}, e\} + p^* + \min\{E\hat{p}^*, e\}$, where p and p^* are defined as above, $E\hat{p}$ represents the expected price for the add-on at firm i, $E\hat{p}^*$ represents the expected price for the add on at the best alternative firm, and e represents the costs for substituting away from the add-on. If firms unshroud, the expected prices $E\hat{p}$ and $E\hat{p}^*$ become the known prices $\hat{p}$ and $\hat{p}^*$, respectively.

Price discrimination. The firm may offer a low-priced add-on and a high-priced add-on. It is assumed that both add-ons are perfect substitutes with the same quality. Correspondingly, informed and uninformed consumers value the low-priced add-on and high-priced add-on equally, but only informed consumers are in a position to substitute away. The goal of a firm that uses price discrimination is that informed consumers who otherwise substitute away buy the low-priced add-on, and the remaining uninformed consumers buy the high-priced add-on. Note that the fraction of informed consumers in this paragraph refers to "pre advertising", i.e. sophisticated and potentially educated myopic consumers, because, as described in the following, the *shrouding/unshrouding* of the price discrimination strategy itself may affect the fraction of informed myopic consumers.

Suppose firms own a technology that allows them to use interpersonal information about consumers (previous purchases, education, etc.) in order to classify them as uninformed or informed consumer. Depending on the industry, product, and customer characteristics, price discrimination works more or less well. Realistically, such a technology has two potential limits:

- The error when firms classify an informed consumer as uninformed is called *attrition.* This error implies that the firm will unintentionally *shroud* (not advertise) the low-priced add-on towards a fraction $1-\beta$ of informed consumers. It follows that this fraction will substitute away.

of a product at firm i, and ε_{ai} represents a random idiosyncratic preference of consumer a that is i.i.d. Depending on the consumer type, the variables v_i and q_i in the decision utility function refer just to the base good or to the base good plus the add-on. It is assumed that all firms produce products with the same quality v. See Gabaix and Laibson (2006), p. 532-533, for details on the microfoundation of the demand function $D(x_i)$.

- The error when firms classify an uninformed consumer as informed consumer is called *cannibalization*. This error implies that the firm will unintentionally *unshroud* (advertise) the low-priced add-on towards a fraction $1-\gamma$ of uninformed consumers. It follows that this fraction buys the low-priced add-on of the firm instead of the high-priced add-on, if they buy at the firm at all.

See Figure 1 for an overview on effects of price discrimination.

Timing. The model has four periods. In period 0 the regulator may intervene. In period 1 firms determine their pricing strategy. In period 2 consumers make a buying decision. In period 3 consumers observe the price of the add-on and decide whether to buy it at the firm.

Period 0:

- The regulator decides whether to educate myopic consumers about the relevance of add-ons.

Period 1:

- Firms choose between uniform pricing (with one standard add-on) and price discrimination (with one low-priced and one high-priced add-on).
- In case of uniform pricing:
  - Firms pick a price for the base good, p, and a price for the standard add-on, $\hat{p}$.
  - Firms decide to make the information about the add-on *shrouded* or *unshrouded*.
- In case of price discrimination:
  - Firms pick a price for the base good, p, a price for the high-priced add-on, $\hat{p}_H$, and a price for the low-priced add-on, $\hat{p}_L$.
  - Firms *unshroud* the high-priced add-on and *shroud* information about the low-priced add-on towards what the firm thinks is an uninformed consumer.
  - Firms *unshroud* the low-priced add-on towards what the firm thinks is an informed consumer.

Period 2:

- Informed consumers (sophisticated and informed myopic) always take the add-on and its price into consideration for their buying decision. If information about the add-on is *shrouded*, sophisticated consumers and informed myopic consumers form Bayesian posteriors about the unobserved add-on.
- Uninformed myopic consumers do not consider the add-on for their buying decision.

Period 3:

- Consumers observe the add-on price (if firms have not *unshrouded* prices already).
- All consumers buy the base good.
- In case of uniform pricing
  - Uninformed consumers buy the standard add-on.
  - Informed consumers buy the standard add-on if the price is at most e, or otherwise substitute away at costs e.
- In case of price discrimination
  - A fraction γ of uninformed consumers (pre advertising) buys the high-priced add-on. A fraction $1-\gamma$ of uninformed consumers (pre advertising) buys the low-priced add-on.
  - A fraction of β of informed consumers (pre advertising) that got informed about the low-priced add-on buys it if the price is at most e, or otherwise substitute away. The remaining fraction of informed consumer (pre advertising) that got informed about the high-priced add-on buys it if the price is at most e (which realistically will never be the case), or otherwise substitute away.

2.2 Price equilibria without educating consumers

This sub-section derives symmetric price equilibria of firms without regulatory intervention. It therefore serves as a benchmark for the evaluation of regulatory intervention. As it is shown in the following, the decisions of firms about *shrouding* or *unshrouding* and offering one add-on (uniform pricing) or two add-ons (price discrimination) result in three potential profit maximizing pricing strategies of the firm.

High-priced add-on. This pricing strategy may make sense if the firm can sell the high-priced add-on to a large fraction of uninformed consumers. The firm therefore *shrouds* information about the add-on because *unshrouding* would decrease the fraction of uninformed consumers. In order to maximize profits, the firm sets the price for the add on to $\hat{p} = \bar{p}$, where $\bar{p}$ is the highest possible price for the add-on. Sophisticated consumers who observe that the firm *shrouds* anticipate this, $E\hat{p} = \bar{p}$, and will substitute away at effort costs e. The expected profit of a firm is given by

$$\pi_h = (p + \alpha\bar{p})D(p^* - p). \qquad (1)$$

See the appendix for details. By solving the first-order condition for $p^* = p$, we get a profit maximizing price for the base good of $p = -\alpha\bar{p} + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_h^* = \mu D(p^* + \alpha\bar{p} - \mu). \qquad (2)$$

Low-priced add-on. This pricing strategy may make sense if the firm can sell the add-on also to sophisticated consumers, who substitute away if they expect a price of the add on $E\hat{p} > e$. The firm therefore sets the price $\hat{p} = e$ and *unshrouds*, i.e. makes the add-on price public, such that sophisticated consumers can observe the price and do not substitute away. All consumers purchase both the base good and the add-on at the firm. The expected profit is given by

$$\pi_l = (p + e)D(p^* - p). \qquad (3)$$

See the appendix for details. By solving the first-order condition for $p^* = p$, we get a profit maximizing price for the base good of $p = -e + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_l^* = \mu D(p^* + e - \mu). \qquad (4)$$

Price discrimination. This pricing strategy may make sense if the firm has a technology to separate between myopic and sophisticated consumers, and to make them separate offers. The firm chooses a price for the low-priced add-on, $\hat{p}$, and a price for the high-priced add-on, $\hat{p}_H$. In order to maximize profits from uninformed consumers, the firm sets the price for the high-priced add on to $\hat{p}_H = \bar{p}$, where $\bar{p}$ is the highest possible price for the add-on. In order to maximize profits from informed consumers who will substitute away if $E\hat{p} > e$, the firm also offers a low-priced add-on to informed consumers for a price $\hat{p}_L = e$. As discussed in sub-section 2.1, efficiency of price discrimination is limited by *attrition* and *cannibalization*. The expected profit of a firm is given by

$$\pi_d = (p + e((1-\alpha)\beta + \alpha(1-\gamma)) + \bar{p}\gamma\alpha)D(-p + p^*) \tag{5}$$

See the appendix for details. By solving the first-order condition for $p^* = p$, we get a profit maximizing price for the base good of $p = -e((1-\alpha)\beta + \alpha(1-\gamma)) - \bar{p}\gamma\alpha + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_d^* = \mu D(p^* + e((1-\alpha)\beta + \alpha(1-\gamma)) + \bar{p}\gamma\alpha - \mu) \tag{6}$$

Symmetric price equilibria. The firm chooses a pricing strategy to maximize its expected profit. The conditions for a *low-priced add-on* strategy are $\pi_l^* > \pi_h^*$ and $\pi_l^* > \pi_d^*$. The conditions for a *high-priced add-on* strategy are $\pi_h^* > \pi_d^*$ and $\pi_h^* > \pi_l^*$. The conditions for a *price discrimination* strategy are $\pi_d^* > \pi_h^*$ and $\pi_d^* > \pi_l^*$. These conditions imply threshold levels for the fraction of myopic consumers of the population, α, that determine the symmetric price equilibrium of all firms. The threshold level depend on substitution costs e, the upper level for the add-on price $\bar{p}$, and the efficiency of product discrimination (the attrition effect, $1-\beta$, and the cannibalization effect, $1-\gamma$).

Proposition 1 (Price equilibrium without regulatory intervention)**.** *Let*

$$\alpha^\dagger = \min\left(\frac{e}{\bar{p}}, \frac{e(1-\beta)}{e(1-\beta) + (\bar{p}-e)\gamma}\right) \tag{7}$$

and

$$\alpha^\ddagger = \max\left(\frac{e}{\bar{p}}, \frac{e\beta}{e\beta + (\bar{p}-e)(1-\gamma)}\right). \tag{8}$$

The firm chooses a low-priced add-on *strategy if $\alpha < \alpha^\dagger$, a* price discrimination *strategy if $\alpha^\dagger < \alpha < \alpha^\ddagger$, and a* high-priced add-on *strategy if $\alpha^\ddagger < \alpha$.*

The threshold level that are defined in Proposition 1 are illustrated in Figure 2. The two following corollaries represent special cases of Proposition 1.

Corollary 1 (Equilibrium without price discrimination)**.** *If price discrimination is not efficient ($\beta \leq 1-\gamma$), which corresponds to $a^\dagger = \alpha^\ddagger = \frac{e}{\bar{p}}$, firms choose a* low-priced add-on *strategy if $\alpha < \frac{e}{\bar{p}}$ and a* high-priced add-on *strategy otherwise.*

Corollary 1 reflects that the positive effect from offering low-priced add-ons to sophisticated and informed myopic consumers, β, is weaker than the cannibalization effect, $1-\gamma$. Note that the threshold level for α of Corollary 1 is equivalent to the threshold level from Gabaix and Laibson (2006) who analyze price equilibria without price discrimination.

Corollary 2 (Equilibrium with fully efficient price discrimination)**.** *If price discrimination is fully efficient ($\beta = 1$), which corresponds to $\alpha^\dagger = 0$ and $\alpha^\ddagger = \frac{e}{e+(\bar{p}-e)(1-\gamma)}$, firms choose a* price discrimination *strategy if $\alpha < \alpha^\ddagger$ and a* high-priced add-on *strategy otherwise. A* low-priced add-on *strategy is no optimal strategy.*

2.3 Price equilibria with educating consumers

Now, suppose that the regulator decides to intervene via educating myopic consumers. A fraction λ of myopic consumers then become *informed consumers* and decide just like sophisticated consumers. It is assumed that education by the regulator and unshrouding are substitutes. This implies that if the regulator decides to educate consumers, the decisions of firms whether to *shroud* or *unshroud* has no further effect on the decision rational of consumers.

High-priced add-on. The expected profit of a firm is given by

$$\pi_h = (p + \bar{p}(1-\lambda)\alpha)D(p^* - p). \tag{9}$$

See the appendix for details. By solving the first-order condition for $p^* = p$, we get a profit maximizing price for the base good of $p = -\bar{p}(1-\lambda)\alpha + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_h^* = \mu D(p^* + \bar{p}(1-\lambda)\alpha - \mu). \tag{10}$$

Low-priced add-on. The profit of a firm under this pricing strategy is the same as without regulatory intervention. The maximized profit is given by

$$\pi_l^* = \mu D(p^* + e - \mu). \tag{11}$$

Price discrimination. The expected profit of a firm is given by

$$\pi_d = (p + e((1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) + \bar{p}(1-\lambda)\gamma\alpha)D(-p + p^*) \tag{12}$$

See the appendix for details. By solving the first-order condition for $p^* = p$, we get a profit maximizing price for the base good of $p = -e((1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) - \bar{p}\alpha\gamma\alpha + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_d^* = \mu D(p^* + e((1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) + \bar{p}(1-\lambda)\gamma\alpha - \mu) \quad (13)$$

Symmetric price equilibria. The firm chooses between the three alternative pricing strategies such that its expected profit is maximized.

Proposition 2 (Price equilibrium with regulatory intervention)**.** *Let* $\alpha^{\S} = \frac{1}{1-\lambda}\alpha^{\dagger}$ *and* $\alpha^{\sharp} = \frac{1}{1-\lambda}\alpha^{\ddagger}$*. The firm chooses a* low-priced add-on *strategy if* $\alpha < \alpha^{\S}$*, a* price discrimination *strategy if* $\alpha^{\S} < \alpha < \alpha^{\sharp}$*, and a* high-priced add-on *strategy if* $\alpha^{\sharp} < \alpha$*.*

The threshold level that are defined in Proposition 2 are illustrated in Figure 3. The two following corollaries represent special cases of Proposition 2.

Corollary 3 (Equilibrium without price discrimination)**.** *If price discrimination is not efficient (*$\beta \leq 1-\gamma$*), which corresponds to* $a^{\S} = \alpha^{\sharp} = \frac{e}{\bar{p}(1-\lambda)}$*, firms choose a* low-priced add-on *strategy if* $\alpha < \frac{e}{\bar{p}(1-\lambda)}$*, and a* high-priced add-on *strategy otherwise.*

Corollary 4 (Equilibrium with fully efficient price discrimination)**.** *If price discrimination is fully efficient (*$\beta = 1$*), which corresponds to* $\alpha^{\S} = 0$ *and* $\alpha^{\sharp} = \frac{1}{1-\lambda}\frac{e}{e+(\bar{p}-e)(1-\gamma)}$*, firms choose a* price discrimination *strategy if* $\alpha < \alpha^{\sharp}$ *and a* high-priced add-on *strategy otherwise. A* low-priced add-on *strategy is no optimal strategy.*

3 Welfare Analysis

This section provides comparative statics for social welfare and consumer protection. First, we analyze effects of price discrimination. This is important for potential actions of the regulator. Second, we analyze effects of educating consumers and derive conditions when it is beneficial for social welfare and when it has adverse effects. Third, we discuss potential pitfalls for the regulator.

3.1 Effects of price discrimination

The measure for *social welfare loss* is given by the number of consumers who substitute away from the add-on multiplied by their effort costs e. Price discrimination increases social welfare under an otherwise *high-priced add-on* equilibrium ($\frac{e}{\bar{p}} < \alpha < \alpha^{\ddagger}$). It decreases social welfare under an otherwise *low-priced add-on* equilibrium ($\alpha^\dagger < \alpha < \frac{e}{p}$). Figure 4 illustrates effects of price discrimination on social welfare.

Besides social welfare, the pricing strategy of firms also affects cross-subsidies from uninformed (myopic) to informed (sophisticated and informed myopic) consumers. Price discrimination decreases prices for myopic consumers under an otherwise *high-priced add-on* equilibrium ($\frac{e}{p} < \alpha < \alpha^\ddagger$) and increases prices for myopic consumers under an otherwise *low-priced add-on* equilibrium ($\alpha^\dagger < \alpha < \frac{e}{p}$). It decrease prices for sophisticated consumers ($\alpha^\dagger < \alpha < \alpha^\ddagger$). Figure 5 illustrates effects of price discrimination on prices of uninformed and informed consumers.

3.2 Effects of educating consumers

Proposition 3 (social welfare)**.** *Educating consumers increases social welfare, if it changes a* high-priced add-on *equilibrium ($\alpha^\ddagger < \alpha < \alpha^\sharp$) or a* price discrimination *equilibrium ($\alpha^\dagger < \alpha < \alpha^\S$). It decreases social welfare, if a high-priced add-on equilibrium ($\alpha^\sharp < \alpha$) or a price discrimination equilibrium ($\alpha^\S < \alpha < \alpha^\ddagger$) remains.*

Table 1 shows the welfare loss or welfare gain from educating consumers for each range of α. Figure 6 illustrates effects of educating consumers on social welfare. A special case where price discrimination is not efficient ($\beta \leq 1 - \gamma$) and only a *low-priced add-on* or a *high-priced add-on* equilibrium exists, is illustrated in Figure 7. A special case where price discrimination is fully efficient ($\beta = 1$) and only a *price discrimination* or a *high-priced add-on* equilibrium exists, is illustrated in Figure 8.

So far, the analysis has focussed on varying fractions of myopic consumers α. The efficiency of educating myopic consumers that is reflected in λ is also important, especially if the regulator can increase λ with high education efforts or with the right strategy. Figure 9 and Figure 10 illustrate effects of educating consumers on social welfare for varying λ. Obviously, educating consumers always causes firms to choose the socially optimal *low-priced add-on* equilibrium for a high λ. Realistically, it is not possible for the regulator to always make a sufficiently large fraction of myopic consumers informed. For example, firms may add complexity to their price structures because it prevents consumers to become informed (Carlin, 2009).

Besides social welfare, the pricing strategy of firms also affects cross-subsidies from uninformed (myopic) to informed (sophisticated and informed myopic) consumers. It is not so clear, if this should also be a concern of the regulator (see, e.g., Armstrong, 2008, p.112). In any case, several alternative measure could be used to evaluate consumer protection.

A simple measure is the fraction of exploited consumers. This fraction obviously decreases through education whenever a *high-priced add-on* equilibrium or a *price discrimination* equilibrium exists (see Table 2).

Figure 11 illustrates how education affects total prices (base good and add-on) of uninformed and informed consumers. It shows that total prices for uninformed consumers increase for a lower α, until a *low-priced add-on* equilibrium is reached. Total prices for informed consumers also increase for a lower α until a *low-priced add-on* equilibrium is reached. *Expected total prices* of myopic consumers reflect that a myopic consumer may become informed but may also stay uninformed after education. The measure is calculated as total prices of an uninformed consumer times the probability that a myopic consumer stays uninformed $(1 - \lambda)$, plus total prices of an informed consumer times the probability that a myopic consumer becomes informed (λ). The *expected* total prices of myopic consumers with education are largely below total prices without education (for $\alpha < 0.7$), even within a *high-priced add-on* or *price discrimination* equilibrium. Interestingly, for a high fraction of myopic consumers ($\alpha > 0.7$), education even increases *expected* total prices of myopic consumers.

3.3 Pitfalls for the regulator

As shown in the previous analysis, effects of educating myopic consumers depend on price equilibria, which in turn depend on the pricing flexibility of firms. The regulator can evaluate effects of educating myopic consumers if full information about the pricing dynamics is available. In many situations, however, this will not be the case.

Figure 12 illustrates a situation when effects of educating consumers depend on the pricing flexibility of firms. Suppose the regulator observes a high-priced add-on equilibrium. The regulator estimates that a fraction $\alpha = 0.6$ of consumers is myopic, and that education could make a fraction $\lambda = 0.3$ of myopic consumers informed. Without knowing if firms own or could acquire a technology for price discrimination, it's not possible for the regulator to evaluate effects of educating consumers. If firms can only apply uniform pricing strategies, educating consumers decreases social welfare. If firms own a technology for price discrimination, educating consumers increases social welfare.

4 Conclusion

Regulatory intervention via educating myopic consumers increases social welfare if it changes the price equilibrium of firms. This is typically the case if education makes a large fraction of myopic consumers informed. For some products and industries, however, it is more realistic that education only reaches some myopic consumers. If regulatory intervention does not change a price equilibrium of firms, educating consumers decreases social welfare. The effect depends on the fraction of myopic consumers (α), the fraction of myopic consumers that get informed when educated (λ), the effort costs of informed consumers when substituting away from add-ons (e) and the upper level for an add-on price ($\bar{p}$). Furthermore, the pricing flexibility of firms (reflected in β and γ) is important for effects of educating consumers.

Educating consumers should only be considered by the regulator if the regulator understands the pricing dynamics of an industry. The regulator thus needs to carefully analyze the situation before intervening via educating myopic consumers and may find no intervention at all or other regulatory strategies more beneficial.

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A Appendix

A.1 Calculations and proofs

High-priced add-on (w/o regulatory intervention). The expected profit of a firm is composed of the expected profit from sales to informed consumers who only purchase the base good, $p(1-\alpha)D(\hat{x}_i)$, and the expected profit from sales to uninformed consumers who buy both the base good and the add-on, $(p+\hat{p})\alpha D(\bar{x}_i)$. The expected profit is given by

$$\begin{aligned}
\pi_h &= p(1-\alpha)D(-p-\min\{E\hat{p},e\}+p^*+\min\{E\hat{p}^*,e\}) \\
&\quad +(p+\hat{p})\alpha D(-p+p^*) \\
&= p(1-\alpha)D(-p-e+p^*+e)+(p+\bar{p})\alpha D(-p+p^*) \\
&= (p+\alpha\bar{p})D(p^*-p)
\end{aligned}$$

The first-order condition for $p^* = p$ is given by

$$-(p+\alpha\bar{p})D'(p^*-p)+D(p^*-p)=0,$$

which results in a profit maximizing price $p=-\alpha\bar{p}+\mu$, where $\mu=\frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_h^* = \mu D(p^*+\alpha\bar{p}-\mu).$$

Low-priced add-on (w/o regulatory intervention). The expected profit of a firm is composed of the expected profit from sales to informed (sophisticated and informed myopic) consumers, $(p+\hat{p})(1-(1-\lambda)\alpha)D(\hat{x}_i)$, and the expected profit from sales to uninformed myopic consumers, $(p+\hat{p})(1-\lambda)\alpha D(\bar{x}_i)$. All consumers purchase both the base good and the add-on at the firm. The expected profit is given by

$$\begin{aligned}
\pi_l &= (p+\hat{p})(1-(1-\lambda)\alpha)D(-p-\min\{E\hat{p},e\}+p^*+\min\{E\hat{p}^*,e\}) \\
&\quad +(p+\hat{p})(1-\lambda)\alpha D(-p+p^*) \\
&= (p+e)(1-(1-\lambda)\alpha)D(-p-e+p^*+e)+(p+e)(1-\lambda)\alpha D(-p+p^*) \\
&= (p+e)D(p^*-p)
\end{aligned}$$

The first-order condition for $p^* = p$ is given by

$$-(p+e)D'(p^*-p)+D(p^*-p)=0,$$

which results in a profit maximizing price for the base good of $p = -e + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_l^* = \mu D(p^* + e - \mu).$$

Price discrimination (w/o regulatory intervention). Price discrimination is not generally fully efficient. First, because of *attrition*, only a fraction β of informed consumers (pre advertising) buys it at the firm, and a fraction $1-\beta$ substitutes away. Second, because of *product cannibalization*, a fraction $1-\gamma$ of myopic consumers becomes informed, and a fraction γ stays uninformed. The expected profit of a firm is given by

$$\begin{aligned} \pi_d &= p(1-\alpha)(1-\beta)D(\hat{x}) \\ &\quad +(p+e)(1-\alpha)\beta D(\hat{x}) + (p+e)\alpha(1-\gamma)D(\hat{x}) \\ &\quad +(p+\bar{p})\alpha\gamma D(\bar{x}) \end{aligned}$$

From $D(\hat{x}) = D(-p - \min\{E\hat{p}, e\} + p^* + \min\{E\hat{p}^*, e\}) = D(-p + p^*)$, and $D(\bar{x}) = D(-p + p^*)$, it follows that

$$\pi_d = (p + e((1-\alpha)\beta + \alpha(1-\gamma)) + \bar{p}\gamma\alpha)D(-p + p^*)$$

By solving the first-order condition

$$-(p + e((1-\alpha)\beta + \alpha(1-\gamma)) + \bar{p}\gamma\alpha)D'(-p + p^*) + D(-p + p^*) = 0$$

for $p^* = p$, we get a profit maximizing price for the base good of $p = -e(1-\alpha)\beta + \alpha(1-\gamma)) - \bar{p}\gamma\alpha + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the optimal profit a firm can make under this pricing strategy is

$$\pi_d 1* = \mu D(p^* + e((1-\alpha)\beta + \alpha(1-\gamma)) + \bar{p}\gamma\alpha - \mu)$$

Corollary 1. If price discrimination is not efficient ($\beta \leq 1-\gamma$), which corresponds to $a^\dagger = \alpha^\ddagger = \frac{e}{\bar{p}}$, firms choose a *low-priced add-on* strategy if $\alpha < \frac{e}{\bar{p}}$ and a *high-priced add-on* strategy otherwise.

The threshold level $\alpha^\dagger$ and $\alpha^\ddagger$ are defined as

$$\alpha^\dagger = \min\left(\frac{e}{\bar{p}}, \frac{e(1-\beta)}{e(1-\beta) + (\bar{p} - e)\gamma}\right)$$

and

$$\alpha^{\ddagger} = \max\left(\frac{e}{\bar{p}}, \frac{e\beta}{e\beta + (\bar{p} - e)(1-\gamma)}\right).$$

These threshold level imply that $\alpha^{\dagger} \leq \frac{e}{\bar{p}}$ and $\alpha^{\ddagger} \geq \frac{e}{\bar{p}}$. It follows that $\alpha^{\dagger} = \alpha^{\ddagger}$ if, and only if, $\alpha^{\dagger} = \frac{e}{\bar{p}}$ and $\alpha^{\ddagger} = \frac{e}{\bar{p}}$. First, $\alpha^{\dagger} = \frac{e}{\bar{p}}$, if $\frac{e}{\bar{p}} \leq \frac{e(1-\beta)}{e(1-\beta)+(\bar{p}-e)\gamma}$. This is the case if $\beta \leq 1-\gamma$. Second, $\alpha^{\ddagger} = \frac{e}{\bar{p}}$, if $\frac{e}{\bar{p}} \geq \frac{e\beta}{e\beta+(\bar{p}-e)(1-\gamma)}$. This is the case if $\beta \leq \frac{\bar{p}-e}{e\bar{p}-e}(1-\gamma)$. Based on the assumptions that $\bar{p} \in (0,1]$ and $e < \bar{p}$, we know that $1-\gamma < \frac{\bar{p}-e}{e\bar{p}-e}(1-\gamma)$. It follows that $\alpha^{\dagger} = \alpha^{\ddagger} = \frac{e}{\bar{p}}$, if $\beta \leq (1-\gamma)$.

High-priced add-on (with regulatory intervention). The expected profit of a firm is given by

$$\begin{aligned}
\pi_h &= p(1-(1-\lambda)\alpha)D(-p - \min\{E\hat{p}, e\} + p^* + \min\{E\hat{p}^*, e\}) \\
&\quad +(p+\hat{p})(1-\lambda)\alpha D(-p+p^*) \\
&= p(1-(1-\lambda)\alpha)D(-p-e+p^*+e) + (p+\bar{p})(1-\lambda)\alpha D(-p+p^*) \\
&= (p+\bar{p}(1-\lambda)\alpha)D(p^*-p)
\end{aligned}$$

By solving the first-order condition

$$-(p+\bar{p}(1-\lambda)\alpha)D'(p^*-p) + D(p^*-p) = 0$$

for $p^* = p$, we get a profit maximizing price for the base good of $p = -\bar{p}(1-\lambda)\alpha + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_h^* \quad = \quad \mu D(p^* + \bar{p}(1-\lambda)\alpha - \mu) \tag{14}$$

Price discrimination (with regulatory intervention). If the firm decides to offer a low-priced version of the add-on to informed consumers, the expected profit is given by

$$\begin{aligned}
\pi_d &= p(1-(1-\lambda)\alpha)(1-\beta)D(\hat{x}) \\
&\quad +(p+e)(1-(1-\lambda)\alpha)\beta D(\hat{x}) + (p+e)(1-\lambda)\alpha(1-\gamma)D(\hat{x}) \\
&\quad +(p+\bar{p})(1-\lambda)\gamma\alpha D(\bar{x})
\end{aligned}$$

From $D(\hat{x}) = D(-p - \min\{E\hat{p}, e\} + p^* + \min\{E\hat{p}^*, e\}) = D(-p+p^*)$, and $D(\bar(x)) = D(-p+p^*)$, it follows that

$$\pi_d \quad = \quad (p + e((1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) + \bar{p}(1-\lambda)\gamma\alpha)D(-p+p^*)$$

By solving the first-order condition

$$-(p + e((1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) + \bar{p}(1-\lambda)\gamma\alpha)D'(-p+p^*) + D(-p+p^*) = 0,$$

for $p^* = p$, we get a profit maximizing price for the base good of $p = -e(1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) - \bar{p}(1-\lambda)\gamma\alpha + \mu$, where $\mu = \frac{D(0)}{D'(0)}$. It follows that the maximized profit of a firm under this pricing strategy is given by

$$\pi_d^* = \mu D(p^* + e((1-(1-\lambda)\alpha)\beta + (1-\lambda)(1-\gamma)\alpha) + \bar{p}(1-\lambda)\gamma\alpha - \mu)$$

A.2 Figures

Figure 1: Overview on effects of price discrimination

The figure shows effects of price discrimination on consumers. The fractions of informed and uninformed consumers (pre advertising) depend on a potential regulatory intervention. In case of no intervention, the fractions are $1-\alpha$ and α, respectively. In case of intervention, the fractions are $1-(1-\lambda)\alpha$ and $(1-\lambda)\alpha$, respectively. The *attrition effect* reflects that the firm will unintentionally not advertise (*shroud*) the low-priced add-on towards a fraction $1-\beta$ of informed consumers. The *cannibalization effect* reflects that the firm may unintentionally advertise (*unshroud*) the low-priced add-on towards a fraction $1-\gamma$ of previously uninformed consumers. If these previously uninformed consumers then become informed, i.e. update their decision rationales, is not really relevant. They will buy the low-priced add-on and not the high-priced add-on anyway. Just for completeness: because education (regulatory intervention) and *unshrouding* are substitutes, myopic consumers can only become informed through *cannibalization* if they did not already become informed through regulatory intervention.

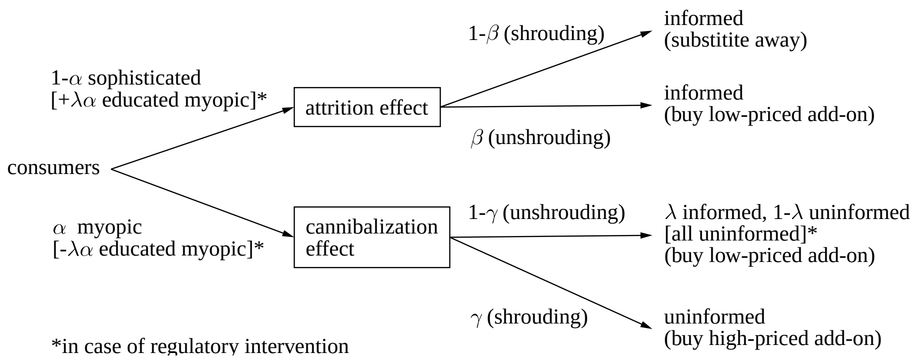


Figure 2: Threshold level for α without regulatory intervention

The threshold level that determine the optimal pricing strategy of a firm are defined as $\alpha^{\dagger} = \min\left(\frac{e}{\bar{p}}, \frac{e(1-\beta)}{e(1-\beta)+(\bar{p}-e)\gamma}\right)$ and $\alpha^{\ddagger} = \max\left(\frac{e}{\bar{p}}, \frac{e\beta}{e\beta+(\bar{p}-e)(1-\gamma)}\right)$. The firm chooses a *low-priced add-on* strategy if $\alpha < \alpha^{\dagger}$, a *price discrimination* strategy if $\alpha^{\dagger} < \alpha < \alpha^{\ddagger}$, and a *high-priced add-on* strategy if $\alpha^{\ddagger} < \alpha$. The figure illustrates a case where price discrimination is efficient ($\beta > 1-\gamma$). If price discrimination is not efficient, it follows that $\alpha^{\dagger} = \alpha^{\ddagger} = \frac{e}{\bar{p}}$. If price discrimination is fully efficient ($\beta = 1$), it follows that $\alpha^{\dagger} = 0$ and $\alpha^{\ddagger} = \frac{e}{e+(\bar{p}-e)(1-\gamma)}$.

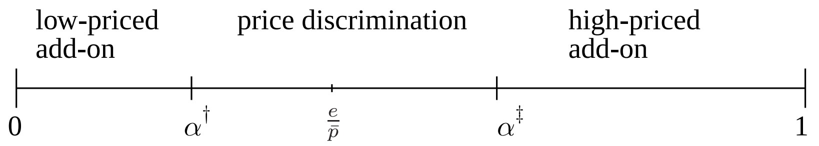


Figure 3: Threshold level for α with regulatory intervention

The threshold level that determine the optimal pricing strategy of a firm are defined as $\alpha^{\S} = \frac{1}{1-\lambda}\alpha^{\dagger}$ and $\alpha^{\sharp} = \frac{1}{1-\lambda}\alpha^{\ddagger}$. The firm chooses a *low-priced add-on* strategy if $\alpha < \alpha^{\S}$, a *price discrimination* strategy if $\alpha^{\S} < \alpha < \alpha^{\sharp}$, and a *high-priced add-on* strategy if $\alpha^{\sharp} < \alpha$.

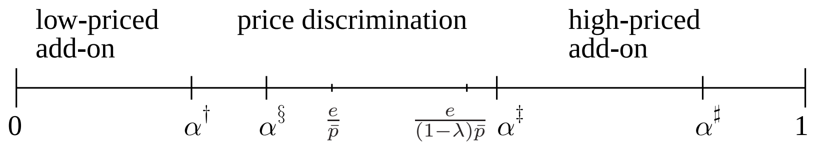


Figure 4: price discrimination and social welfare

The figure illustrates *social welfare loss* for varying α with price discrimination and with uniform pricing. Suppose price discrimination is not fully efficient ($\beta = 0.7$ and $\gamma = 0.7$), $\bar{p} = 1$ and $e = 0.3$.

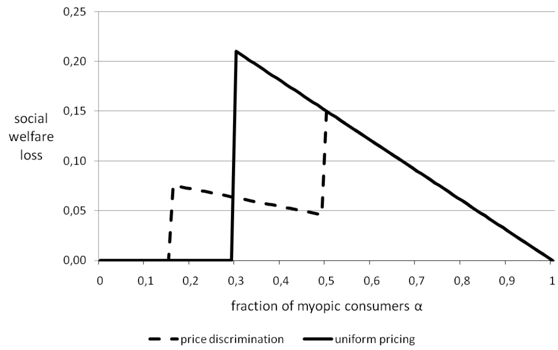


Figure 5: price discrimination and prices

Suppose price discrimination is not fully efficient ($\beta = 0.7$ and $\gamma = 0.7$), $\bar{p} = 1$ and $e = 0.3$.

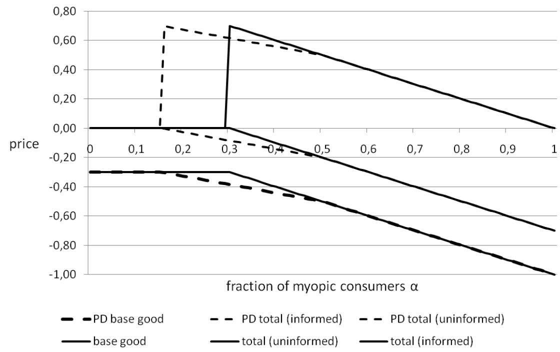


Figure 6: education and social welfare loss

The figure illustrates *social welfare loss* for varying α, with and without education. Suppose educating consumers makes 30% of myopic consumers informed.

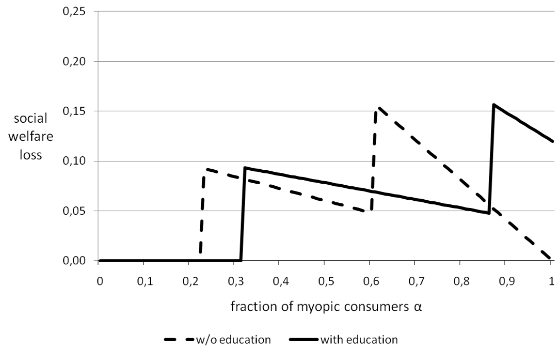


Figure 7: education and social welfare loss (uniform pricing and fixed λ)

It is assumed that $\lambda = 0.25$, $e = 0.25$, and $\bar{p} = 1$. The social welfare loss without regulatory intervention is shown as dotted line, and the social welfare loss with regulatory intervention is shown as solid line. Without regulatory intervention, a social welfare loss comes from a shrouded price equilibrium for $\alpha > 0.25$. With regulatory intervention, a social welfare loss comes from a shrouded price equilibrium for $\alpha > 0.33$.

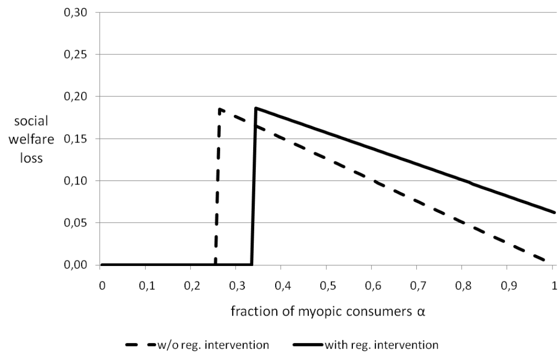


Figure 8: education and social welfare loss (price discrimination and fixed λ)

It is assumed that $\lambda = 0.25$, $\gamma = 0.2$, $e = 0.25$, and $\bar{p} = 1$. The social welfare loss without regulatory intervention is shown as dotted line. The social welfare loss is shown as solid line. Without regulatory intervention, a social welfare loss comes from a shrouded price equilibrium with uniform pricing for $\alpha > 0.625$. With regulatory intervention, a social welfare loss comes from a shrouded price equilibrium with uniform pricing for $\alpha > 0.833$.

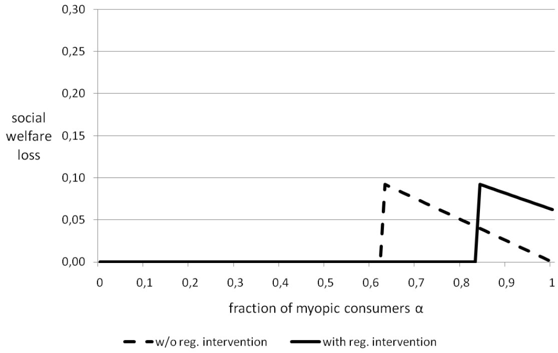


Figure 9: education and social welfare loss (uniform pricing and fixed α)

It is assumed that $\alpha = 0.75$, $e = 0.25$, and $\bar{p} = 1$. The social welfare loss without regulatory intervention that is due to a shrouded price equilibrium is shown as dotted line. The social welfare loss with regulatory intervention that is due to a shrouded price equilibrium is shown as solid line.

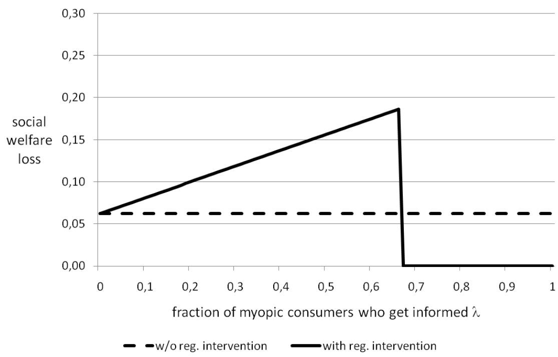


Figure 10: education and social welfare loss (price discrimination and fixed α)

It is assumed that $\alpha = 0.75$, $\gamma = 0.2$, $e = 0.25$, and $\bar{p} = 1$. The social welfare loss without regulatory intervention is shown as dotted line. The social welfare loss with regulatory intervention is shown as solid line.

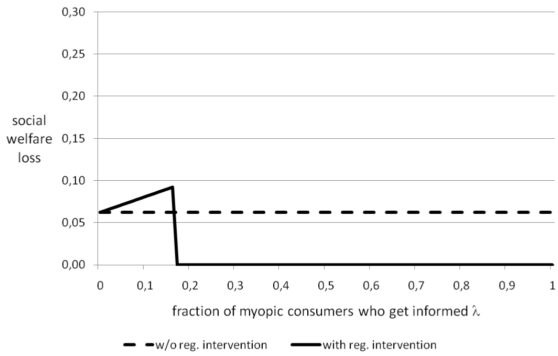


Figure 11: education and prices

Suppose educating consumers makes 30% of myopic consumers informed.

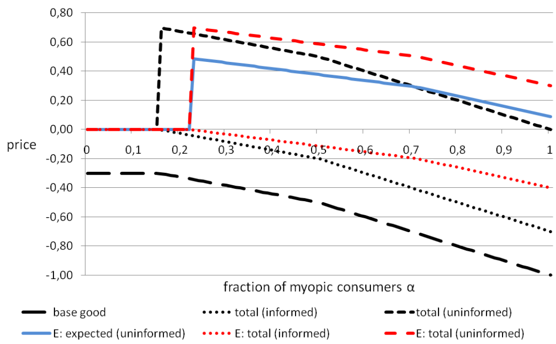
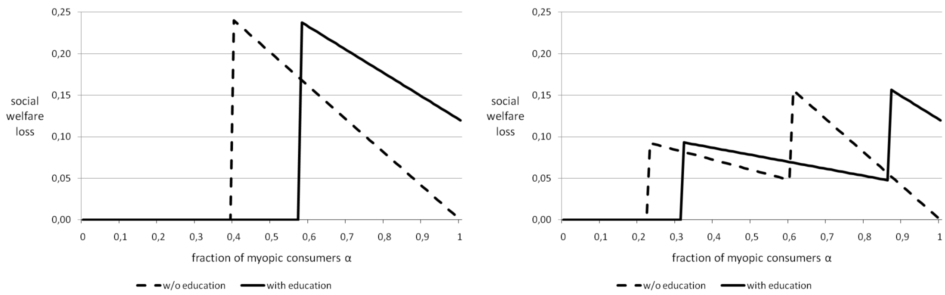


Figure 12: pitfalls of the regulator

Suppose the regulator observes *high-priced add-ons*, and estimates a fraction of myopic consumers $\alpha = 0.6$ and effects of education $\lambda = 0.3$.



(a) uniform pricing (b) price discrimination

A.3 Tables

Cells without any shading represent a *low-priced add-on* equilibrium. Cells with a light grey shading represent a *price discrimination* equilibrium. Cells with a dark grey shading represent a *high-priced add-on* equilibrium. The following thresholds apply (see Proposition 1 and Proposition 2):

$\alpha^{\dagger} = \min\left(\frac{e}{\bar{p}}, \frac{e(1-\beta)}{e(1-\beta)+(\bar{p}-e)\gamma}\right)$

$\alpha^{\S} = \frac{1}{1-\lambda}\alpha^{\dagger}$

$\alpha^{\ddagger} = \max\left(\frac{e}{\bar{p}}, \frac{e\beta}{e\beta+(\bar{p}-e)(1-\gamma)}\right)$

$\alpha^{\sharp} = \frac{1}{1-\lambda}\alpha^{\ddagger}$

Table 1: Social welfare loss

The first row shows the social welfare loss without education, the second row shows the social welfare loss with education, and the third row shows the resulting effect of education.

$\alpha < \alpha^{\dagger}$	$\alpha^{\dagger} < \alpha < \alpha^{\S}$	$\alpha^{\S} < \alpha < \alpha^{\ddagger}$	$\alpha^{\ddagger} < \alpha < \alpha^{\sharp}$	$\alpha^{\sharp} < \alpha$
0	$(1-\beta)(1-\alpha)e$	$(1-\beta)(1-\alpha)e$	$(1-\alpha)e$	$(1-\alpha)e$
0	0	$(1-\beta)(1-(1-\lambda)\alpha)e$	$(1-\beta)(1-(1-\lambda)\alpha)e$	$(1-(1-\lambda)\alpha)e$
0	$-(1-\beta)(1-\alpha)e$	$(1-\beta)\lambda\alpha e$	$-(\beta(1-\alpha)-(1-\beta)\lambda\alpha)e$	$\lambda\alpha e$

Table 2: Fraction of exploited consumers

The first row shows the social welfare loss without education, the second row shows the social welfare loss with education, and the third row shows the resulting effect of education.

$\alpha < \alpha^{\dagger}$	$\alpha^{\dagger} < \alpha < \alpha^{\S}$	$\alpha^{\S} < \alpha < \alpha^{\ddagger}$	$\alpha^{\ddagger} < \alpha < \alpha^{\sharp}$	$\alpha^{\sharp} < \alpha$
0	$(1-\gamma)\alpha$	$(1-\gamma)\alpha$	α	α
0	0	$(1-\gamma)(1-\lambda)\alpha$	$(1-\gamma)(1-\lambda)\alpha$	$(1-\lambda)\alpha$
0	$-(1-\gamma)\alpha$	$-(1-\gamma)\lambda\alpha$	$-(\lambda+\gamma-\lambda\gamma)$	$-\lambda\alpha$